INSTALLATION AND OPERATING INSTRUCTIONS

RADIO RECEIVER

SE-1220

ENGINEERING DEPARTMENT

Radiomarine Corporation of America

A Radio Corporation of America Service

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498M - 5M - 11-36

Description and Directions for the Use of U. S. Navy Medium Wave Receiver

Type SE 1220

This instrument is designed primarily for the reception of spark signals; secondarily for the reception of sustained waves, using an audion control box as detector. A four pole, double throw switch in the receiver permits of the use of either crystal detector or audion, both of which may be permanently connected to the receiver.

The range of the primary of this receiver and of the tuned secondary is 300 to 6,800 meters.

The receiver circuit, with detector switch on "AUDION," is shown schematically in Fig. 1.

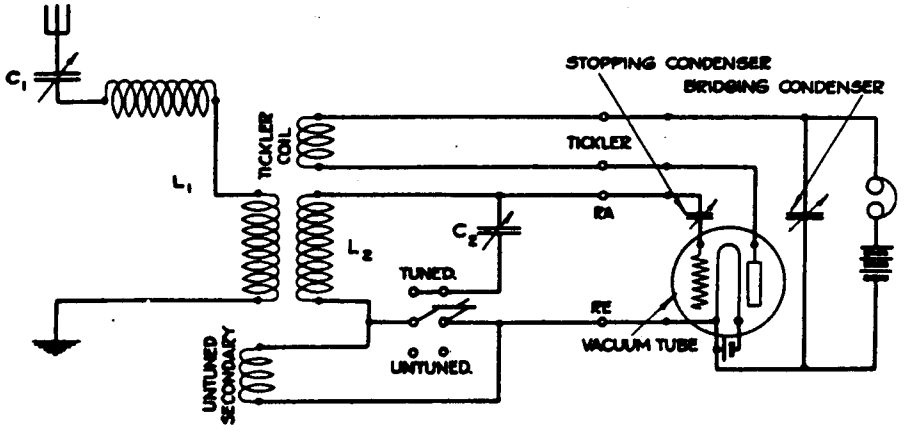


FIG. 1.

The receiver circuit, with detector switch on "CRYSTAL," is shown schematically in Fig. 2.

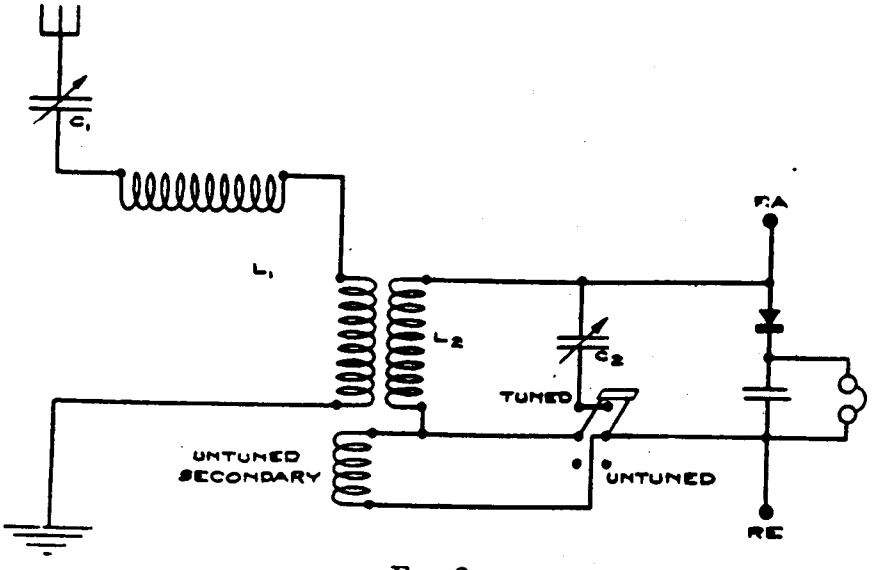


FIG. 2.

Tuning

The antenna is tuned by means of the series variable coondenser C_1 and the 10-step variable inductance L_1. The secondary is tuned by the shunt variable condenser C_2 and the 6-step variable inductance L_2. A double pole, double throw switch in the receiver permits of the use of either the tuned secondary or the untuned secondary. The latter consists of a coil coupled to the primary and placed in series wtih the secondary inductance; the secondary condenser is cut out of the circuit when the untuned secondary is used.

Coupling

This receiver differs from others of earlier design in that it has no capacitive coupler; the coupling between the primary and secondary circuits is purely inductive. The coupler is designed to afford either loose or close coupling on long or short waves with a point of minimum coupling for any wave length.

DETAILED SPECIFICATIONS

Antenna Circuit

The antenna circuit of this receiver has a wave length range of 300 to 6,800 meters when used with an antenna of 0.0008 mf. capacity. The antenna circuit consists of a large, air dielectric, variable condenser, minimum capacity about 0.00008 mf. and maximum capacity about 0.0045 mf.; a primary cylindrical loading coil, a primary rectangular section loading coil, a primary coupling coil, inductance switches and coil cutouts.

The cylindrical loading coil consists of a micarta tube 5 inches outside diameter and 6.00 inches long, wound with a five bank winding of 408 turns of 3 x 16 x 38 Belden Litzendraht, and has an inductance of about 15 millihenries.

The primary coupling coil is 5 inches in outside diameter, 2 inches long, wound with a double bank winding of 47 turns of 3 x 38 Belden Litzendraht, and has an inductance of 0.42 millihenries.

The primary cylindrical loading coil is wound in three sections; an air gap of ½ inch separating the first 135 turns from the remaining 273. This sectionalizing scheme is adopted to cut down both the distributed capacity and the natural period of the coil.

The primary rectangular section loading coil consists of a spool, inside winding diameter 2.20 inches, outside diameter of coil 4.50 inches, width of slot 1.05 inches. The coil consists of 23 layers of 3 x 16 x 38 Litzendraht, 21 turns per layer, making a total of 483 turns. This loading coil is placed inside the primary cylindrical loading coil, at the long wave end.

The primary condenser is of the balanced plate type. The fixed and movable plate systems are in two sections arranged 180 degrees from each other to balance the movable plate system mechanically. A knob is mounted on the receiver panel to the left and below the handle of the variable condenser, and permits of fine adjustment of the primary condenser through gears connected to the movable plates. A small sector, of 7 degrees, is cut from each end of the movable plates of the condenser. A sector, of 10 degrees, is cut from each end of the fixed plates of the condenser. This increases the ratio of maximum to minimum wave length of each coil, by reducing the end plate capacity of the condenser to a minimum. The movable plate system carries a German silver dial on which the antenna wave lengths may be marked either in pencil or in India ink. An external loading coil may be inserted into the antenna circuit by connecting to the binding posts marked LOAD COIL after removing the short circuiting link.

Secondary Circuit

The secondary circuit has a wave length range of from 300 to 6,800 meters. There is an overlap of at least 35 per cent on each of the steps of secondary coil.

Tuned Secondary

The tuned secondary circuit consist of a cylindrical inductance coil shunted by an air dielectric variable condenser. The loading coil is 5 inches in diameter, 7.5 inches long, is wound with a double bank winding of 188 turns of 3 x 16 x 38 Belden Litzendraht, and has an inductance of 4.25 millihenries. This coil is wound in three sections; a 7/16-inch air gap separated the first 43 turns from the second section and a 3/16-inch air gap separates the second section (70 turns) from the third section (75 turns). This sectionalizing scheme cuts down both the distributed capacity and natural period of the coil.

The secondary air dielectric condenser has a minimum capacity of about 0.00006 mf. and a maximum capacity of about 0.0032 mf. The movable plate system carries a German silver dial on which wave lenghts and condenser degrees are marked. The fixed and movable plates are cut back like the plates of the primary condenser in order to obtain a high ratio of maximum to minimum wave length on any inductance tap, by reducing the end plate capacity to a minimum. A knob is mounted on the receiver panel to the right of and below the handle of the variable condenser for fine adjustments such as are necessary in shortwave arc work.

Extra secondary loading coils may be inserted between the posts marked LOAD COIL after removing the short circuiting link.

Untuned Secondary

The untuned secondary consists of the tuned secondary, without the secondary condenser, in series with a coil mounted over the primary coupling coil. This arrangement gives close coupling between the primary and secondary circuits, for pick-up work, both on long and short waves. The additional coil is 6 inches in diameter and 5/8 inches long and is wound with a four bank winding of 72 turns of 3 x 16 x 38 Belden Litzendraht. A double pole, double throw switch permits of the use of either the tuned or untuned secondary. When the tuned secondary is used, the additional coupling coil is short circuited; when the untuned secondary is used the secondary condenser is cut out of circuit. The untuned secondary is so designed that its presence in the secondary circuit does not cause any detuning of the primary. Thus it is possible to pick up a station on the untuned secondary, switch to the tuned side and adjust the secondary circuit to resonance with the incoming signal without changing the primary condenser setting more than a few degrees.

Coupling

The primary is inductively coupled to the secondary by means of a movable primary coupling coil. Precautions were taken in the design of this receiver to cut down the residual capacitive coupling between the primary and secondary circuits. There is no fixed inductive coupling between the two circuits since all the coils in the receiver are mutually perpendicular. It is possible to secure a point of minimum coupling between primary and secondary circuits on all wave lengths within the range of the receiver. Medium and tight coupling can be obtained on short waves; medium coupling on long waves.

When receiving arc signals, maximum signal strength and selectivity are obtained when the antenna is tuned to exact resonance (loudest signal, independent of beat no e) using the loosest coupling possible, then tightening the coupling for loudest signal. It follows then, that when a signal is picked up, itt should be reduced to unit audibility by loosening the coupling. Then the antenna should be tuned for maximum signal. The beat frequency (or note), should always be varied by the fine adjustment knob of the secondary condenser. Other adjustments also vary the beat frequency, but only incidentally to their true purpose and should not be so used, except where haste demands.

A slight improvement in selectivity occurs by using a beat frequency as low as 300 or 400 cycles, for example. Maximum signal for a low note occurs at a looser coupling than for a high note, especially on longer wave lengths.

It will be found that the beat note is sharply varied by the coupling adjustment and by the antenna tuning when the coupling is tighter than necessary for maximum signal with a resonant antenna. If the beat notte can be changed, say 500 cycles, by antenna tuning, it can be taken as conclusive proof that the coupling is tighter than that giving a maximum ratio of signal to static, or maximum selectivity of the receiver.

For pick-up work the untuned secondary of the receiver is to be used with the inductive coupler set at about 100 degrees. After the primary is tuned for maximum signal, and if interference or static is present, the tuned secondary should be used and the coupling loosened to the lowest point consistent with a good readable received signal.

Tickler System

The tickler system of this receiver consists of a rectangular section coil 2.875 inches inside diameter, 4 inches outside diameter, 3/4 inch wide. The winding consists of 160 turns of Belden Litzendraht. The tickler is to be connected in series with the plate circuit of the audion and is coupled to the secondary at the short wave end of the secondary coil to provide sufficient coupling to the secondary on short waves.

Buzzer Circuit

The buzzer circuit consists of a battery, a buzzer and a push button switch, all in series. From one terminal of the buzzer a coil of 12 turns of No. 16 wire, 0.5 inch in diameter is wound round the antenna lead. The buzzer is thus capacitively coupled to the antenna and shock excites the antenna into oscillations in its own natural period. Outside batteries (1 to 3 volts) are to be connected to the terminals marked "BUZ. BAT." The buzzer is intended to test the adjustment of the crystal and may be used to indicate whether audion is oscillating. (A low hissing sound will be heard in the telephone if the buzzer is operated while the bulb is oscillating.)

Stopping Condenser

A mica dielectric condenser, variable in five steps of 0.0005 mfds. each is included in the receiver and is connected across the telephoones when the detector switch is on the CRYSTAL side. The effect of the presence of the stopping condenser in the circuit is to broaden the tuning of the secondary by increasing the decrement of the secondary circuit. This is due to the greater flow of high frequency current through the crystal.

INSTALLATION AND WIRING

1. This receiver should be kept as far as possible from metal bulkheads. The set should be placed at least 6 inches from all metal surfaces for best results, and under no condition should it be placed closer than 2.00 inches to such surfaces.

2. Make all leads as short as possible, of not less than No. 14 B. & S. gauge, stranded copper wire.

3. Do not use lead covered wires except for battery and telephone leads.

4. Connect terminals marked RE, RA and TICKLER to the corresponding binding posts on the audion control box. Do not use twisted leads for tickler coil connections as a resonant tickler coil may result. (10 feet. of lamp cord have a capacity of 0.000122 mfds.)

5. Connect terminals marked AUD. TEL. to the binding posts marked TELEPHONES on the audion control box, (If type CF 122, CF 76 or SE 1071.)

6. Connect telephones to the terminals marked TELEPHONES on the receiver panel.

7. Connect crystal detector to the terminals marked DETECTOR on the receiver panel.

8. Be sure that the FILAMENT battery and PLATE battery leads are connected to the proper binding posts on the audion control box.

OPERATION

Pick-up Work

FOR PICK-UP WORK:

1. Set the TUNED-UNTUNED switch on UNTUNED side.
2. Set inductive coupler at about 100 degrees.
3. Adjust stopping condenser to its maximum value.
4. Vary the primary condenser and inductance till maximum signal is obtained.

Selective Work

5. Throw switch to the TUNED side and adjust secondary capacity and inductance till maximum signal is obtained.

As a rule, it will be found that the use of the untuned secondary does not detune the primary circuit, so that only a slight readjustment of the primary, if any, is necessary after throwing from the untuned to the tuned side of the secondary.

Sharpest tuning, or maximum selectivity on spark signals, is obtained by cutting all the stopping condenser out of the circuit and using the loosest coupling giving a loud signal, with both antenna and secondary circuits tuned to resonance with the incoming wave. The point of minimum coupling of this receiver is between 5 and 20 degrees on the coupling scale.

When the knob of the inductive coupler is turned counterclockwise, so that the primary coupling coil rotates beyond its position of minimum coupling, the direction of the E.M.F. induced in the secondary is opposite the direction of the E.M.F. induced when the coupling coil is rotated clockwise beyond its position of zero inductive coupling, (phase difference of 180° between the two voltages).

This feature is incorporated in the receiver so as to provide a means of bucking whatever residual capacitive coupling may exist between the antenna and secondary circuits, by providing a counter E.M.F. to the E.M.F. due to static coupling.

Broadest tuning or pick-up work is best accomplished by the use of from 90 degrees to maximum coupling on the inductive coupler with all the secondary capacity disconnected from the circuit. This can be done by setting the TUNED-UNTUNED switch on the UNTUNED side and increasing the stopping condenser to its maximum value.

Regeneration

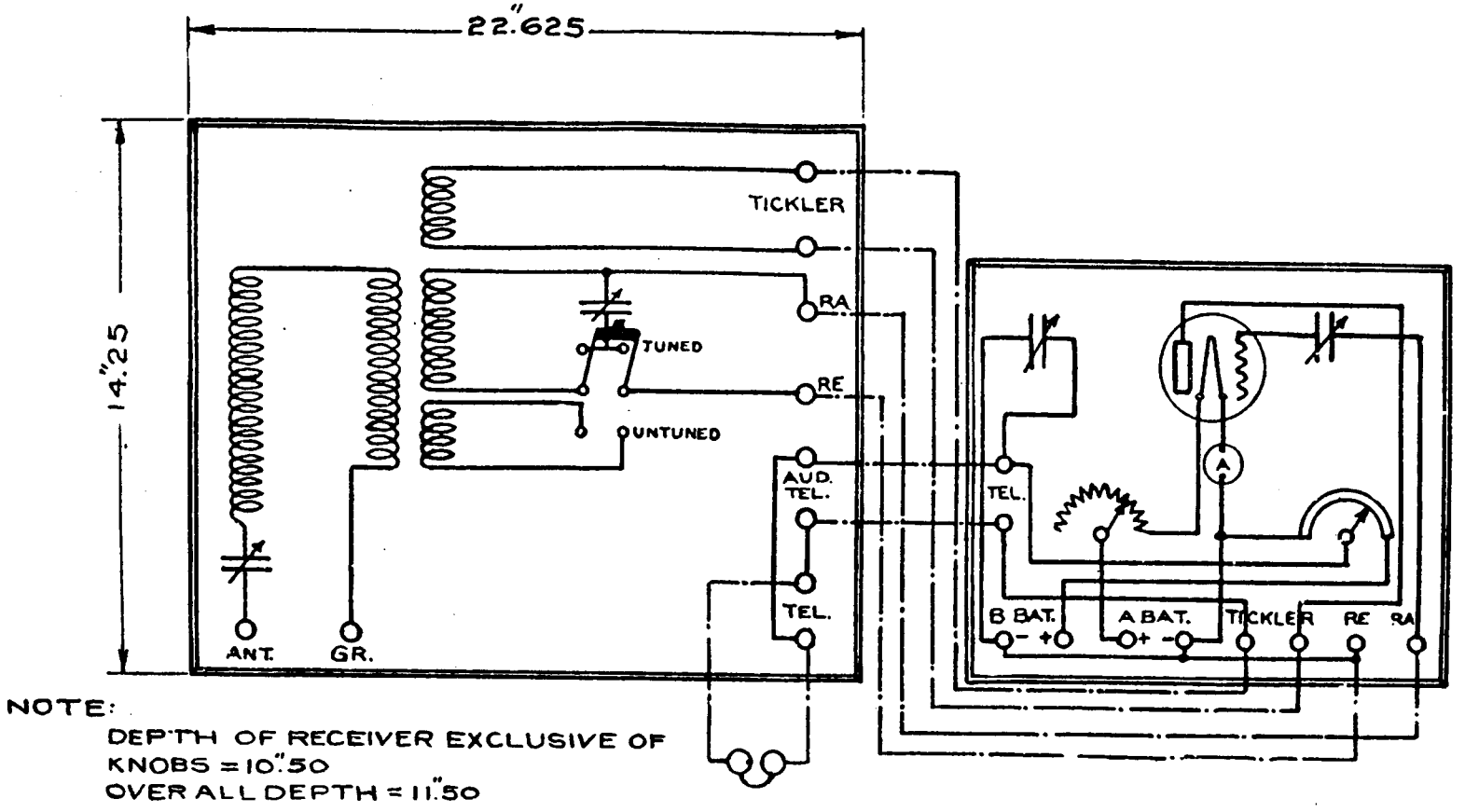
Spark signals may be amplified on all wave lengths by setting the switch on the audion control box on the contact marked OSCLR and increasing the tickler coupling to the point just before oscillations begin. An amplification of 3 to 10 times may be obtained by the method. This phenomenon is known as regeneration.

For selective reception of arc signals, loosen the tickler coupling as much as possible; use loosest coupling between primary and secondary circuits; adjust antenna circuit till it is in resonance with the received wave (maximum signal due to antenna tuning and independent of heterodyne note).

A schematic wiring diagram of the receiver and audion control box type CF 76 or CF 122 shown on page 9; of the receiver and Navy Type SE 1071 Audion Control Box on page 10.

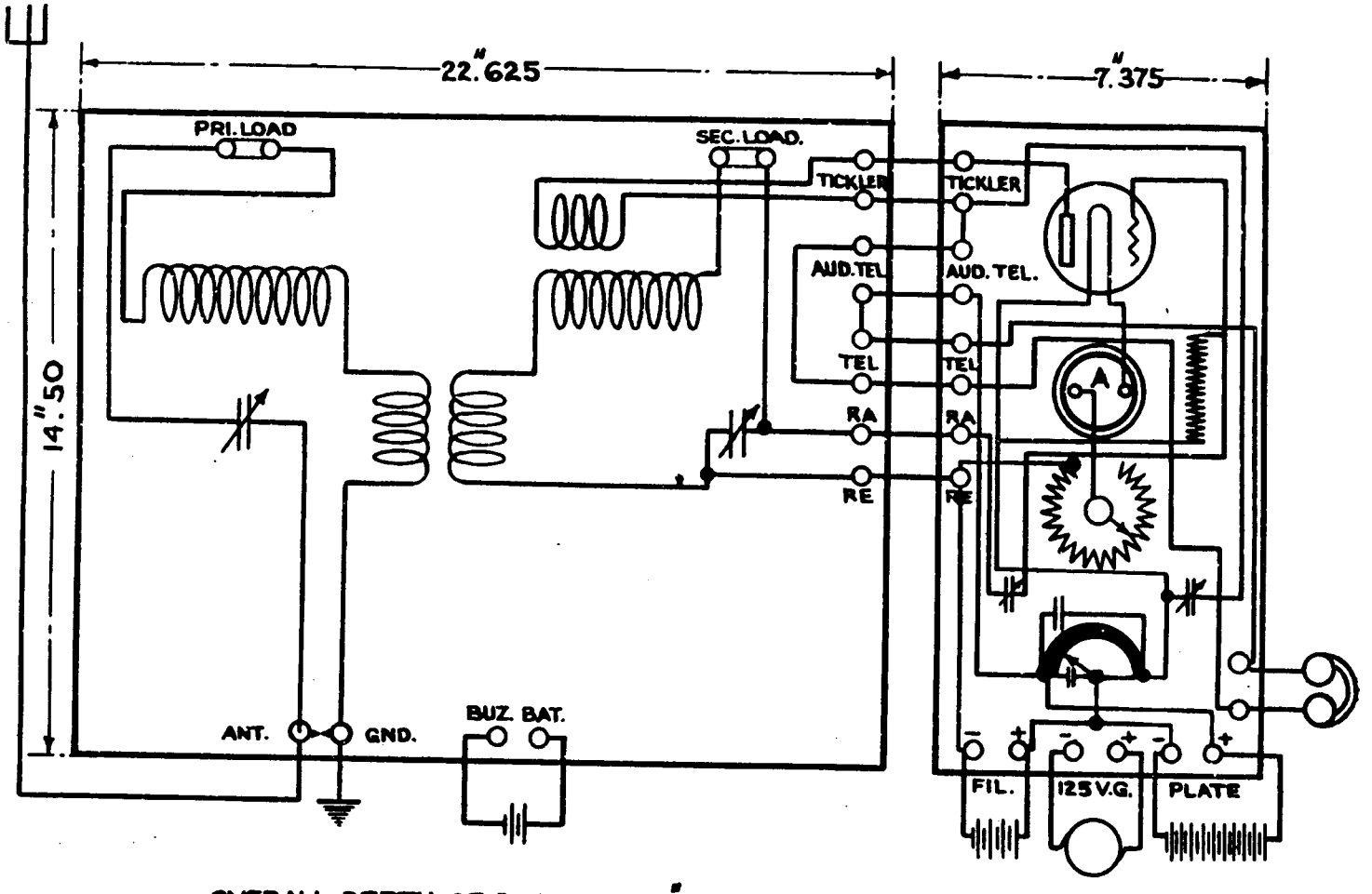
Photographs of the front and rear of the receiver panel are shown on pages 12 and 13 respectively.

A wiring diagram of the medium wave receiver is shown on page 11; a type drawing is shown on page 14.



NOTE:
DEPTH OF RECEIVER EXCLUSIVE OF KNOBS = 10".50
OVER ALL DEPTH = 11".50

SCHEMATIC WIRING DIAGRAM OF RECEIVER TYPE SE 1220
AND AUDION CONTROL BOX, TYPE CF 76 OR CF 122.

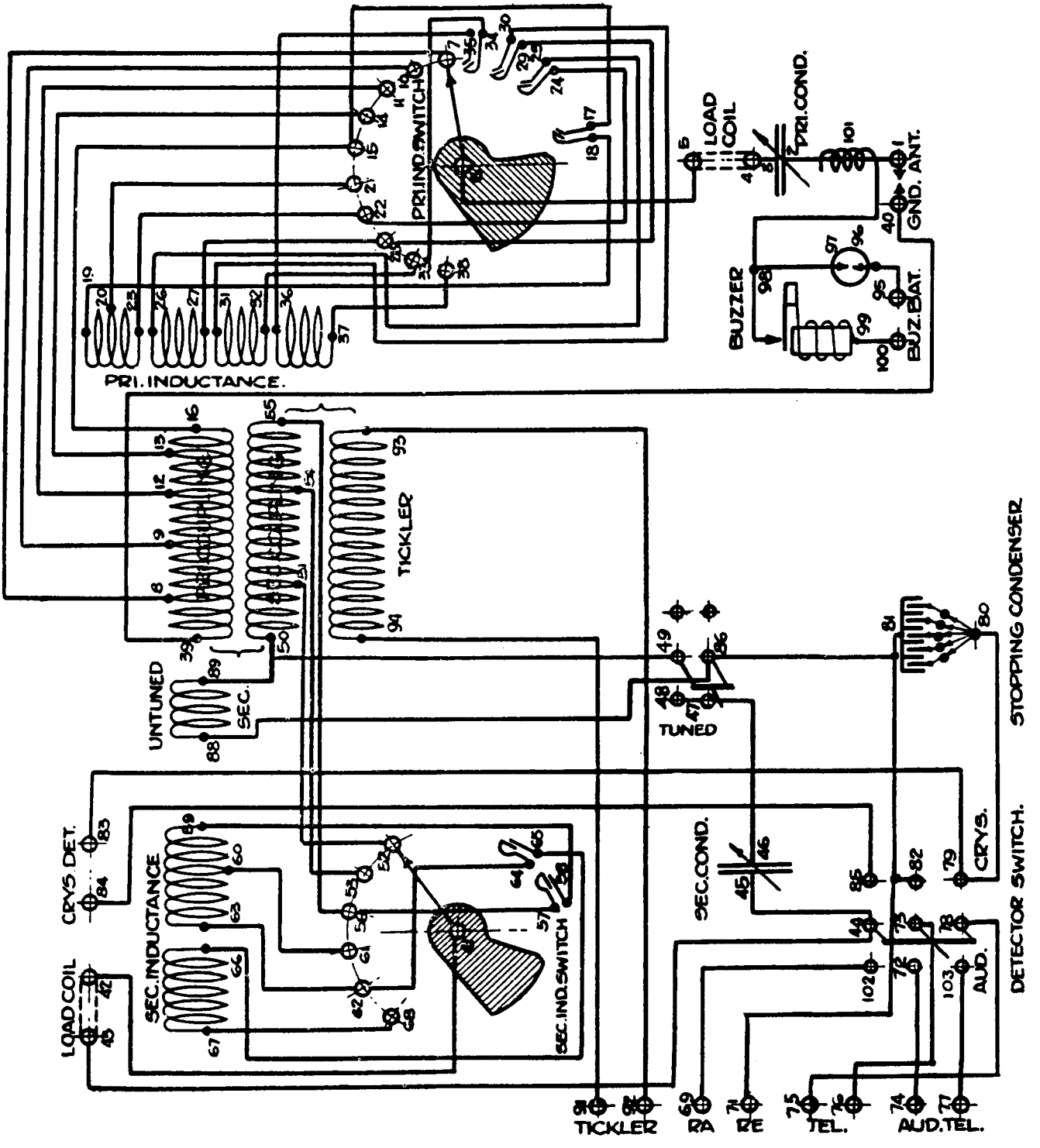


OVERALL DEPTH OF RECEIVER = 11.50"

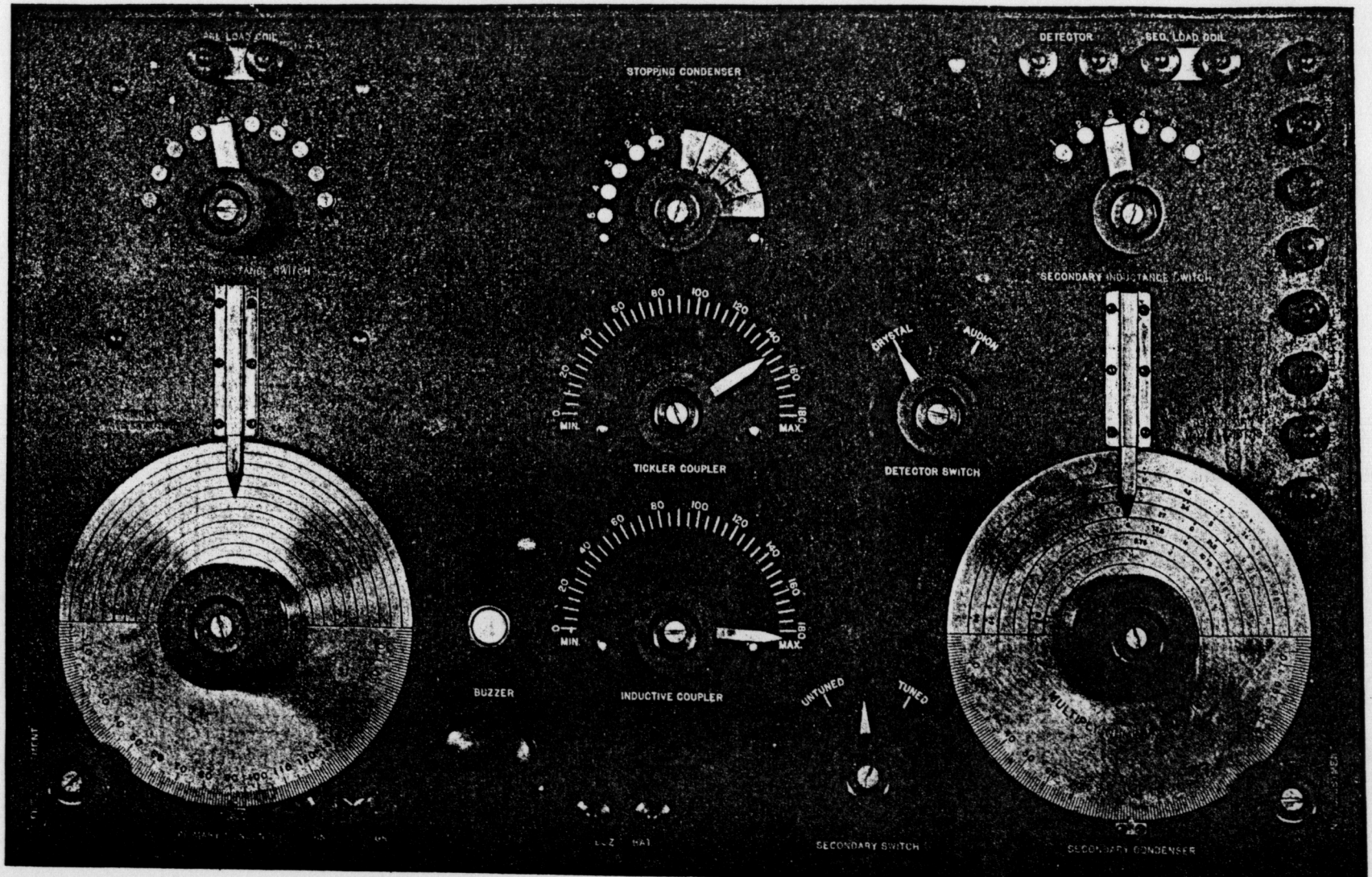
OVERALL DEPTH OF AUDION CONTROL BOX = 7.00"

TYPES SE 143, SE 143A AND SE 1220. TYPE SE 1071

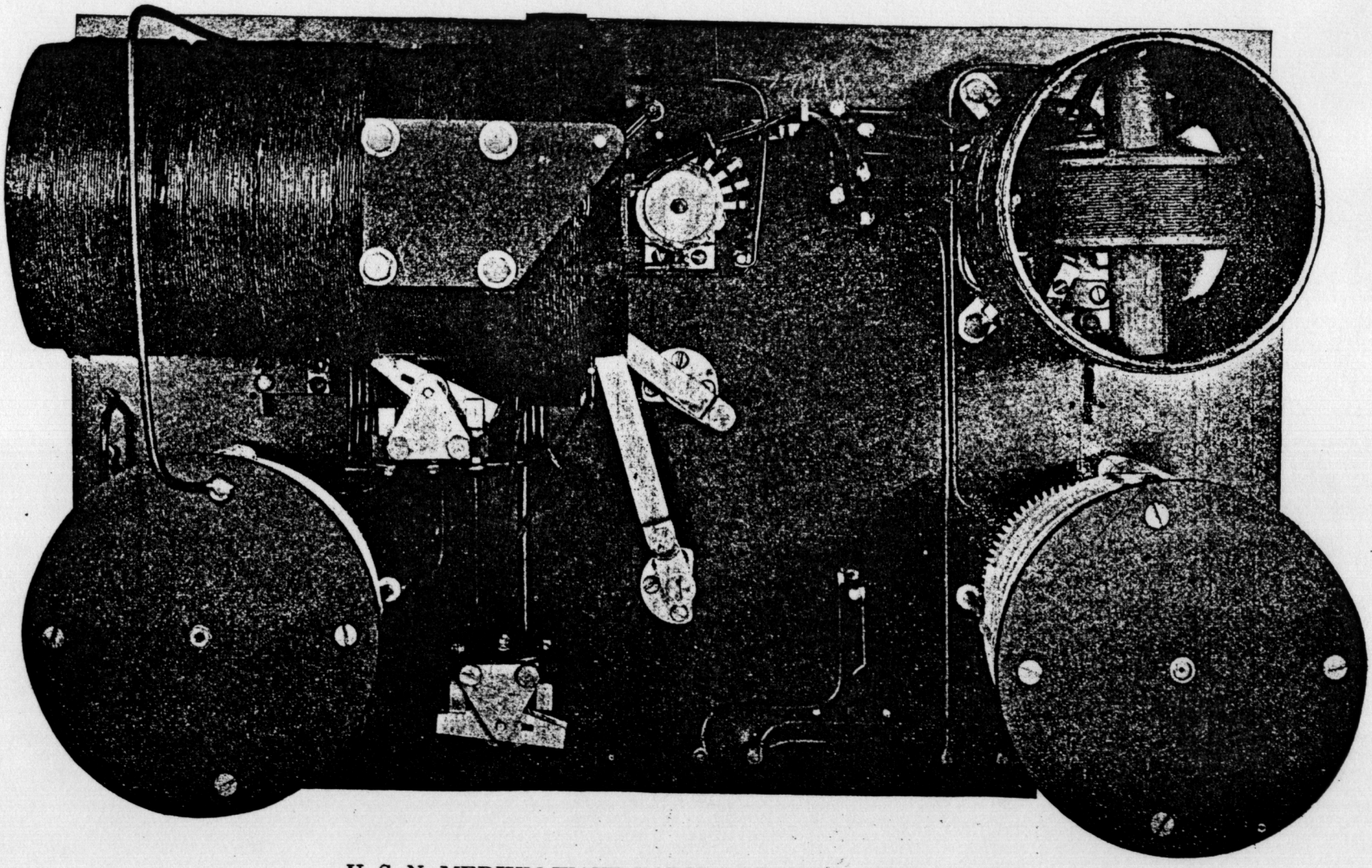
SCHEMATIC WIRING DIAGRAM OF RECEIVER, TYPE SE 1220 AND AUDION CONTROL BOX, TYPE SE 1071



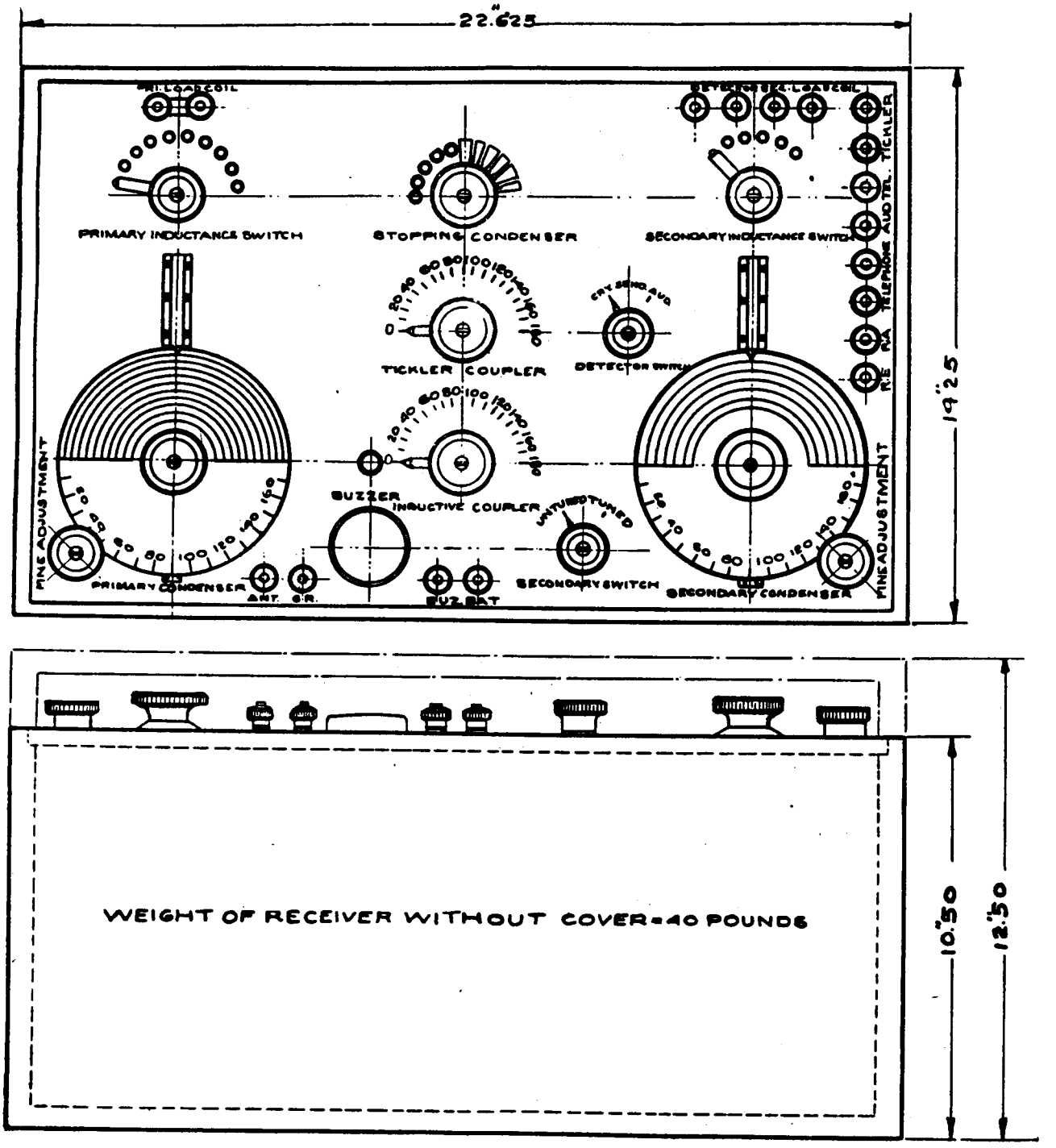
U. S. N. MEDIUM WAVE RADIO RECEIVER, TYPE SE 1220
WIRING DIAGRAM



U. S. N. MEDIUM WAVE RADIO RECEIVER, TYPE SE 1220
PANEL VIEW



U. S. N. MEDIUM WAVE RADIO RECEIVER, TYPE SE 1220
REAR VIEW



U. S. N. MEDIUM WAVE RECEIVER, TYPE SE 1220
TYPE DRAWING

SUMMARY

PROCEDURE FOR OBTAINING OSCILLATIONS

Procedure For Obtaining Oscillations

1. Set switch blade of audion control box on OSCLR. A grid leak of about 500,000 ohms should be connected between grid and the positive terminal of the FILAMENT battery if not already installed. (A grid leak is incorporated in the Navy Type SE 1071 Audion Control Box.)

2. Set stopping condenser switch blade so that about half the capacity is in.

3. Do same with bridging condenser.

4. Set tickler coupling at about 90 degrees.

5. Raise filament current to proper amount (0.9 to 1.1 amp. for most bulbs).

6. Raise plate voltage.

TESTS FOR OSCILLATION

A clicking sound will be heard in the telephones if bulb is oscillating.

1. When momentary contact switch marked TEST (on panel of audion control box) is pushed in.

2. When Binding Post marked RA is touched.

3. When antenna circuit is brought into resonance with the secondary circuit with medium inductive coupling.

4. When tickler coupling is tightened (periodic clicks).

5. If buzzer is operated and bulb is oscillating, a soft hissing sound will be heard.

Failure to Obtain Oscillations

May be due to:

1. Reversed tickler leads.
2. Reversed Plate Battery.
3. Insufficient tickler coupling.
4. Small stopping condenser.
5. Small bridging condenser.
6. Defective vacuum tube.
7. Defective grid leak.

ADJUSTMENTS

Pick-up Work

1. Set switch on UNTUNED side.

2. Set inductive coupler at about 100 degrees.

3. For short wave pick-up work set secondary inductance switch at tap 2; for long wave work, set inductance switch at tap 4.

If crystal detector is used:

4. Set stopping condenser, on receiver panel, at its maximum value.

5. Adjust crystal detector to sensitive point.

6. Vary primary capacity and inductance till maximum signal is obtained. Adjust inductive coupler to maximum signal.

Selective Work

7. Throw switch to TUNED side.

8. Reduce stopping condenser to its minimum value. Use loosest tickler coupling possible (zero for spark reception).

9. Loosen inductive coupling, tuning secondary and readjusting primary at same time.

10. Reduce coupling till a signal a little louder than a "just readable" signal and somewhat weaker than a signal of 1/3 the maximum intensity obtainable is secured. This signal is a good signal for selective spark work.

Tuning to a Known Wave

1. Adjust crystal to a sensitive point.

2. Set tickler coupling at 90 degrees, if oscillating bulb is used. (Set tickler at zero if crystal is used.)

3. Vary secondary capacity and inductance till wave length desired is opposite pointer.

4. Vary primary capacity and inductance till wave length desired is opposite pointer. The primary circuit of this receiver is to be calibrated on shipboard when connected to the ship's antenna.

This may be done as follows:

a) Set secondary circuit in oscillation, with loose tickler coupling.

b) Use loose inductive coupling between the antenna and secondary circuits.

c) Vary antenna condenser and inductance till a characteristic double click is heard in the phones. This occurs when the antenna circuit is in tune with the secondary

d) Loosen inductive coupling slowly and readjust primary till the clicks occur within about 4 degrees from each other on the antenna condenser scale.

e) The wavelength of the antenna at the average position is then the same as the wavelength of the tuned (and calibrated) secondary.

CARE

1. Clean and burnish all contacts occasionally.

2. Clean switch blades occasionally; if they do not make good contact, tighten them.

3. See that no metal objects rub against any of the leads.

4. Clean the front and rear of the panel occasionally with clean, dry cloth.

5. Clean buzzer contacts with crocus cloth.

6. Make sure that all binding posts make good contact with the leads.

7. Clean ANT-GND safety gap with crocus cloth and clean paper.

TREAT THIS RECEIVER WITH THE CARE AND CONSIDERATION DUE AN INSTRUMENT OF ITS KIND.